

GRADE LEVEL CONTENT EXPECTATIONS

8 MATH

v.6.04

NUMBER & OPERATIONS

ALGEBRA

MEASUREMENT

GEOMETRY

DATA & PROBABILITY

Welcome to a preview of Michigan's mathematical future! This document not only introduces Michigan's new Grade Level Content Expectations for mathematics, it also establishes high expectations in mathematics to better prepare all K-12 Michigan students for the challenges of the future.

Creating grade-level expectations involves a complex combination of understanding of mathematics, curriculum, student learning, teaching, current practices, and policy. Curriculum directors, mathematics educators, and classroom teachers from Michigan school districts across the state, together with mathematics and mathematics education faculty from universities across the state, have been involved in the development and/or review of the **Michigan Mathematics Grade Level Content Expectations**. The GLCE are intended to be usable as a framework for the development of grade-by-grade assessments, and to provide teachers with a guide for their instructional and curricular emphases in classrooms. The expectations were constructed to feature continuity from one grade to the next, and to ensure coherence both mathematically and pedagogically. These expectations represent a challenge toward which to aspire; in some cases, teachers and mathematics educators will be called on to move beyond their current practice and experience into territory that will be both demanding and rewarding. Michigan students can rise to the challenge of high academic standards. This document provides a set of ambitious goals for all of us.

This document is intended to be an assessment tool. This means students will be expected to be proficient in the concepts and skills included in this document at the end of the indicated grade level. These expectations are written to convey intended performances by students. The expectations here generally represent key landmarks in mathematics learning — areas where students are expected to have consolidated their understandings and skills. Thus it does not attempt to elaborate all of the precursor ideas and concepts that lead to a particular expectation in a particular grade level — it instead assumes that teachers will build up to the expectations through exploration and development of concepts and processes

The Grade Level Content Expectations are not designed to be a curriculum document, or to function as a scope and sequence framework. It is not designed to suggest the various pedagogical options and strategies that might best enable students to attain these expectations. Rather, it should serve as a basis for the development of a curriculum and instructional strategies that would help the students attain the concepts and skills necessary to meet the GLCE. Various groups are being organized

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to develop clarification documents, content examples, more elaborated explanations, and suggestions for professional development that would support these expectations. Ultimately, teachers, school personnel and district leaders will need to collaborate and draw on their own professional wisdom and experience, as well as on research, to decide how best to organize instruction to help their students meet these expectations.

The mathematics content expectations have been organized into five strands: Number and Operations, Algebra, Geometry, Measurement, and Data and Probability.

These expectations are being presented in two formats; one designed to show specific grade level expectations and a second to show how the expectations transition from one grade level to the next. In the **grade level** format the expectations are organized first by the five strands. Each of the strands is then broken down into content pieces titled “Topics” in an attempt to cluster related ideas for teaching continuity. Under each “Topic” are listed the expectations.

The second format is a “**cross-grade**” version, which has been designed with the intent that one grade level can be easily compared with another and to highlight the mathematical growth that is envisioned across the grades. This format also has been organized into the five strands. However, each strand has been subdivided into broader, more conceptual groupings called “Domains,” to allow for cross grade comparison of the expectations. In several of the strands, the “domains” are similar to the “standards” in *Principles and Standards for School Mathematics* from the National Council of Teachers of Mathematics. In the “cross-grade” version, some key expectations are “cross-listed” in grey when they seem especially crucial to the development of another strand. For instance, several strands from the Number and Operations strand are also listed in grey in the Algebra strand.

Although this organization does not include what have typically been called “process” strands, the importance of mathematical process in the development of these proficiencies cannot be underestimated. Embedded within these expectations are emphases on representation, problem solving, and reasoning as appropriate. The importance of making mathematical connections is conveyed through the cross listing. Finally, the process of communication is foundational to all of mathematics learning.

With the cooperation of all those involved in the education of Michigan students, we can enable our young people to attain the highest standards – and thereby open doors for them to have fulfilling and successful lives in a quantitatively and technologically complex future.

EIGHTH GRADE

The main areas of emphasis for eighth grade are algebra, geometry, and data. In Algebra, students explore non-linear functions with a concentration on quadratic functions. Functions are studied through various representations: symbolic, graphical, with tables, and verbal statements. In Geometry, students consolidate their knowledge of two- and three-dimensional shapes and their properties, and apply this knowledge to perimeter, area, volume, and visualization problems. In Data and Probability, students take the basic knowledge gained to this point, and apply it to making decisions and performing basic analyses of data sets. Common probability misconceptions and bias in data presentation are addressed. Throughout these areas, students use their understanding of number and measurement, developed primarily prior to eighth grade, to solve more complex problems.

NUMBER AND OPERATIONS	Understand real number concepts
	<p>N.ME.08.01 Understand the meaning of a square root of a number and its connection to the square whose area is the number; understand the meaning of a cube root and its connection to the volume of a cube.</p> <p>N.ME.08.02 Understand meanings for zero and negative integer exponents.</p> <p>N.ME.08.03 Understand that in decimal form, rational numbers either terminate or eventually repeat, and that calculators truncate or round repeating decimals; locate rational numbers on the number line; know fraction forms of common repeating decimals, e.g., $0.\overline{1} = \frac{1}{9}$; $0.\overline{3} = \frac{1}{3}$.</p> <p>N.ME.08.04 Understand that irrational numbers are those that cannot be expressed as the quotient of two integers, and cannot be represented by terminating or repeating decimals; approximate the position of familiar irrational numbers, (e.g., $\sqrt{2}$, $\sqrt{3}$, π) on the number line.</p> <p>N.FL.08.05 Estimate and solve problems with square roots and cube roots using calculators.</p> <p>N.FL.08.06 Find square roots of perfect squares and approximate the square roots of non-perfect squares by locating between consecutive integers, e.g., $\sqrt{130}$ is between 11 and 12.</p>
	Solve problems
	<p>N.MR.08.07 Understand percent increase and percent decrease in both sum and product form, e.g., 3% increase of a quantity x is $x + .03x = 1.03x$.</p> <p>N.MR.08.08 Solve problems involving percent increases and decreases.</p> <p>N.FL.08.09 Solve problems involving compounded interest or multiple discounts.</p> <p>N.MR.08.10 Calculate weighted averages such as course grades, consumer price indices, and sports ratings.</p> <p>N.MR.08.11 Solve problems involving ratio units such as miles per hour, dollars per pound, or persons per square mile.</p>

Understand the concept of non-linear functions using basic examples

A.RP.08.01 Identify and represent linear functions, quadratic functions, and other simple functions including inverse functions ($y = k/x$), cubics ($y = ax^3$) roots, ($y = \sqrt{x}$), and exponentials ($y = a^x$, $a > 0$), using tables, graphs, and equations.

A.PA.08.02 For basic functions, e.g., simple quadratics, direct and indirect variation, and population growth, describe how changes in one variable affect the others.

A.PA.08.03 Recognize basic functions in problem context, e.g., area of a circle is πr^2 , volume of a sphere is $\frac{4}{3} \pi r^3$, and represent them using tables, graphs, and formulas.

A.RP.08.04 Use the vertical line test to determine if a graph represents a function in one variable.

Understand and represent quadratic functions

A.RP.08.05 Relate quadratic functions in factored form and vertex form to their graphs and vice versa; in particular, note that solutions of a quadratic equation are the x-intercepts of the corresponding quadratic function.

A.RP.08.06 Graph factorable quadratic functions, finding where the graph intersects the x axis and the coordinates of the vertex; use words “parabola” and “roots”; include functions in vertex form and those with leading coefficient -1 , e.g., $y = x^2 - 36$, $y = (x - 2)^2 - 9$; $y = -x^2$; $y = -(x - 3)^2$.

Recognize, represent, and apply common formulas

A.FO.08.07 Recognize and apply the common formulas:

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

$$(a + b)(a - b) = a^2 - b^2; \text{ represent geometrically.}$$

A.FO.08.08 Factor simple quadratic expressions with integer coefficients, e.g.,

$x^2 + 6x + 9$, $x^2 + 2x - 3$ and $x^2 - 4$; solve simple quadratic equations, e.g., $x^2 = 16$ or $x^2 = 5$ (by taking square roots); $x^2 - x - 6 = 0$, $x^2 - 2x = 15$ (by factoring); verify solutions by evaluation.

A.FO.08.09 Solve applied problems involving simple quadratic equations.

Understand solutions and solve equations, simultaneous equations, and linear inequalities

A.FO.08.10 Understand that to solve the equation $f(x) = g(x)$ means to find all values of x for which the equation is true, e.g., determine whether a given value, or values from a given set, is a solution of an equation (0 is a solution of $3x^2 + 2 = 4x + 2$, but 1 is not a solution).

A.FO.08.11 Solve simultaneous linear equations in two variables by graphing, by substitution, and by linear combination; estimate solutions using graphs; include examples with no solutions and infinitely many solutions.

A.FO.08.12 Solve linear inequalities in one and two variables, and graph the solution sets.

A.FO.08.13 Set up and solve applied problems involving simultaneous linear equations and linear inequalities.

<p>GEOMETRY</p>	<p>Understand and use the Pythagorean Theorem</p> <p>G.GS.08.01 Understand at least one proof of the Pythagorean Theorem; use the Pythagorean Theorem and its converse to solve applied problems including perimeter, area, and volume problems.</p> <p>G.LO.08.02 Find the distance between two points on the coordinate plane using the distance formula; recognize that the distance formula is an application of the Pythagorean Theorem.</p> <p>Solve problems about geometric figures</p> <p>G.SR.08.03 Understand the definition of a circle; know and use the formulas for circumference and area of a circle to solve problems.</p> <p>G.SR.08.04 Find area and perimeter of complex figures by sub-dividing them into basic shapes (quadrilaterals, triangles, circles).</p> <p>G.SR.08.05 Solve applied problems involving areas of triangles, quadrilaterals, and circles.</p> <p>Understand concepts of volume and surface area, and apply formulas</p> <p>G.SR.08.06 Know the volume formulas for generalized cylinders ((area of base) × height), generalized cones and pyramids ($\frac{1}{3}$(area of base) × height) and spheres ($\frac{4}{3}\pi$ (radius)³) and apply them to solve problems.</p> <p>G.SR.08.07 Understand the concept of surface area, and find the surface area of prisms, cones, spheres, pyramids, and cylinders.</p> <p>Visualize solids</p> <p>G.SR.08.08 Sketch a variety of two-dimensional representations of three-dimensional solids including orthogonal views (top, front, and side), picture views (projective or isometric), and nets, use such two-dimensional representations to help solve problems.</p> <p>Understand and apply concepts of transformation and symmetry</p> <p>G.TR.08.09 Understand the definition of a dilation from a point in the plane, and relate it to the definition of similar polygons.</p> <p>G.TR.08.10 Understand and use reflective and rotational symmetries of two-dimensional shapes, and relate them to transformations to solve problems.</p>
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DATA AND	Draw, explain, and justify conclusions based on data
PROBABILITY	<p>D.AN.08.01 Determine which measure of central tendency (mean, median, mode) best represents a data set, e.g., salaries, home prices for answering certain questions; justify the choice made.</p> <p>D.AN.08.02 Recognize practices of collecting and displaying data that may bias the presentation or analysis.</p> <p>Understand probability concepts for simple and compound events</p> <p>D.PR.08.03 Compute relative frequencies from a table of experimental results for a repeated event, and be able to answer questions about the result, using relationship of probability to relative frequency.</p> <p>D.PR.08.04 Apply the Basic Counting Principle to find total number of outcomes possible for independent and dependent events, and calculate the probabilities using organized lists or tree diagrams.</p> <p>D.PR.08.05 Understand the relationship of probability to relative frequency.</p> <p>D.PR.08.06 Understand the difference between independent and dependent events, and recognize common misconceptions involving probability, e.g., Alice rolls a 6 on a die three times in a row; she is just as likely to roll a 6 on the fourth roll as she was on any previous roll.</p> <p>D.AN.08.07 Compute relative frequencies from a table of experimental results for a repeated event; understand the relationship of experimental probability to relative frequency; answer questions regarding the results.</p>